

# **CHAR DWELLERS' ADAPTATION TO CLIMATE CHANGE**



**A Dissertation for the Degree of Master in Disaster Management**

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## Abstract

Climate disaster like flood, river erosion puts a lot of pressure especially on char dweller's whose responsibility is to remain together as family and earn subsistence in day to day life. The main objective of this research is to identify the perception of char dwellers regarding their livelihood option and their capacity to cope with climate change and prioritize the adaptation option for reducing their vulnerability. Kazipur upazila in Sirajganj district was selected as research area due to flood proneness of the area and char dweller's vulnerability to climate changes in agricultural and livestock sectors. A pre tested questionnaire was used to interview 50 respondents to elicit the perception of char dweller's regarding climate change and their preferred adaptation options.

An insignificant section of respondent had observation on extra water level rise and appreciation about high temperature. Majority of the respondents mentioned (78%) flood as natural process. To overcome the natural disaster in char areas they change crop patterns with seasons, select time of cultivation after prediction of natural disaster and to survive and earn livelihood they also select occupation with season. They cultivate mostly Boro and Rabi paddy during January to June. Most of the respondents mentioned about their reduced livelihood options, suffer from different types of diseases, earning loss, taking loan with high interest and losing household asset as the impacts of natural disaster exacerbated by the erratic behavior of climate. They also mentioned that they need to migrate (90%), loss of their and cattle's food (80%), become poor (80%) and interrupt education (96%) as a result of flood. The respondents mostly used pond and river water (42%) for daily uses. For drinking purposes they also used (40%) tube well. They mentioned the following options to adapt with the climate change. They changed their crop pattern (80%), need place to stay during flood, cyclone etc natural disasters (80%), need high land to preserve livestock (86%), temporary income options needed (70%), need clean water supply (90%). The conducted study tried to capture a snapshot of how climate change is already affecting people living in poverty. Finally, adaptation options are urgently needed for the reducing Char Dweller's vulnerability.

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# CHAPTER 1

## INTRODUCTION

### 1.1 Background

Although most may not have a name for it, everyone in Bangladesh has noticed that the climate is changing. As summers grow hotter, and winters milder, once familiar weather patterns grow increasingly extreme and erratic. Many that there are now only four seasons instead of the usual six, causing devastation for farmers. More intense and frequent cyclones, prolonged floods, increased river and coastal erosion, droughts and salinity of farmland are all environmental problems made worse by climate change. The world's climate is changing and will continue to change. Risks associated with these changes are real but highly uncertain.

Societal vulnerability to the risks associated with climate change may exacerbate ongoing social and economic challenges. The investigations were explored the nature of risk and vulnerability in the context of climate change and review the evidence on present-day adaptation in developing countries. The delta of three rivers, the Brahmaputra, Ganges, and Meghna, has created the land of Bangladesh. The combined flow of these three rivers makes this the third greatest river system in the world (ISPAN, 1993).

In the dynamics of erosion and accretion in the rivers of Bangladesh, the sandbars emerging as islands within the river channel, or as attached land to the riverbanks, often create new opportunities to establish settlements and pursue agricultural activities on them. Once vegetated, such lands are commonly called chars in Bangladesh. The first half of this paper provides a brief overview of the agro-economic and natural resource basis of the Chars. The second half of the paper then considers the rural livelihoods of the poor in the Chars areas, and the role of specific sub-sectors and emerging rural economic enterprise development issues. This is based upon a small survey conducted by the authors and case studies of key informants. Bangladesh is recognized worldwide as one of the countries most vulnerable to the impacts of global warming and climate change. This is due to its unique geographic location, dominance of floodplains, and low elevation from the sea, high population density, high levels of poverty, and overwhelming dependence on nature, its resources and services. The country has a history of extreme climatic events claiming millions of lives and destroying past development gains. The people and social system have knowledge and experience of coping with their effects to some degree and extent. Variability in rainfall pattern, combined with increased snow



melt from the Himalayas, and temperature extremes are resulting in crop damage and failure, preventing farmers and those dependent from meaningful earning opportunities. In a changing climate the pattern of impacts are eroding our assets, investment and future. This stands for families, communities and the state. Global warming and climate change country and people know this better than Bangladesh, where millions of people are already suffering. Sudden, severe and catastrophic floods have intensified and taking place more frequently owing to increased rainfall in the monsoon. Over the last ten years, Bangladesh has been ravaged by floods of catastrophic proportion in 1998, 2004 and 2007. Heavy downpour over short spell has resulted in landslides. Cold spell claims human lives as well as damage crops. Droughts often affect even coastal districts. Bad weather keeps the coastal waters risky for fishing expeditions. Damages and losses due to climatic extremes like floods, cyclones, tornados, and droughts are phenomenal to the victims as well as the state. These are early signs of global warming effects. Sea level rise in the coming decades will create over 25 million climate refugees.

Bangladesh is recognized worldwide as one of the country's most vulnerable to the impacts of global warming and climate change. This is due to its unique geographic location, dominance of floodplains, and low elevation from the sea, high population density, high levels of poverty, and overwhelming dependence on nature, its resources and services. The country has a history of extreme climatic events claiming millions of lives and destroying past development gains. The people and social system have knowledge and experience of coping with their effects - to some degree and extent. Variability in rainfall pattern, combined with increased snow melt from the Himalayas, and temperature extremes are resulting in crop damage and failure, preventing farmers and those dependent from meaningful earning opportunities. In a changing climate the pattern of impacts are eroding our assets, investment and future. This stands for families, communities and the state. Global warming and climate change threaten settlements and the number of people displaced from their land due to riverbank erosion, permanent inundation and sea level rise is increasing rapidly every year. Resource and effort of government and people are quickly drained addressing the impact of one event when another hazard strikes. Impacts of global warming and climate change have the potential to challenge our development efforts, human security and a future.

## **1.2 General objective**

To assess the impact of climate change on Livelihood pattern of existing hazards in Char **areas** and how char dwellers can adapt their livelihood to Climate change in future course of actions.

## **1.3 Specific objectives**

- i) To examine the effect of climate change on existing hazards in Char areas.
- ii) To assess the impact of climate change on Livelihood pattern of Char Dwellers
- iii) To estimate how char dwellers can adapt their livelihood to Climate change in future course of actions.

## **1.4 Research Questions**

This paper will seek to answer two associated questions:

- To what extent does the climate Change has its impact on livelihood of Char Dwellers in different **areas** of Bangladesh?
- How does climate change affecting Char dwellers Adaptation in Bangladesh?

## **1.5 Rationale**

Damages and losses due to climatic extremes like floods, cyclones, tornados, and droughts are phenomenal to the victims as well as the state. These are early signs of global warming effects. Sea level rise in the coming decades will create over 25 million climate refugees. Bangladesh is recognized worldwide as one of the most vulnerable countries to the impacts of global warming and climate change. This is due to its unique geographic location, dominance of floodplains, and low elevation from the sea, high population density, high levels of poverty, and overwhelming dependence on nature, its resources and services. The country has a history of extreme climatic events claiming millions of lives and destroying past development gains (Talukder and Ahmed, 1992). Global warming and climate change threatens settlements and the number of people displaced from their land due to riverbank erosion, permanent inundation and sea level rise is increasing rapidly every year. Resource and effort of government and people are quickly drained addressing the impact of one event when another hazard strikes. Impacts of global warming and climate change have the potential to challenge development efforts, human security and their future livelihood.

The coastal and char geomorphology of Bangladesh are characterized by funnel shaped, vast network of river, strong tidal and wind action and enormous river discharge laden with bed and suspended sediments. Therefore, the geo-climatic environment of these areas are strongly influenced by the Bay of Bengal situated in the southern part of Bangladesh (Mahmood et al., 1994), and are dominated by following three main factors, which are considered as the major causes of natural catastrophes, such as - a) Wind direction, b) Precipitation and c) River and terrestrial runoff. Aside with these, wide and open coast, strong current and wind, dynamics of erosion and siltation, natural slopping of the continent etc. are considered as the silent features behind the causing of natural disasters. The poverty monitoring survey done by Bangladesh Bureau of Statistics (BBS, 1999, 2002) in 1999 identified different natural disasters like tornados, river bank erosion, salinity intrusion, water stagnation, heavy rainfall etc. as the main causes of perpetuating char poverty. *As Char Livelihood is different, the detail assessment of char dwells' adaptation to climate change need to be done to understand their hazard situation. More so, correct assessment of vulnerability will ensure the proper utilization of development fund.* So it is imperative to study the impact of climate change on in char areas of Bangladesh.

## CHAPTER 2 LITERATURE REVIEW

Bangladesh must move on in its pursuit to develop and strive as a nation, taking into account its vulnerability, susceptibility and capacity to manage climate risks and adaptation. In this respect, the government has taken bold steps to prepare and respond to the challenge already on us. To help the country and its people build necessary capacity and resilience, regional and international cooperation is essential. Major rivers that draws freshwater and sediment from upstream basin to the Bay of Bengal going through Bangladesh originate in neighboring countries and water flow during both summer and dry period is critical for agriculture and food and drinking water security. Collective actions are necessary now to understand risks and take actions. International efforts in planning responses to climate change must act urgently to avoid what is unmanageable and manage the unavoidable. The case of Bangladesh, one of the first and major victims of human induced global warming and climate change, should be taken seriously and addressed collectively. Our hands hold our future. We must secure the well-being and development of Bangladesh by making the people and country resilient, through necessary resource and support, both internal and external. Together, we must address this challenge and demonstrate our environmental integrity to the human race. Specially, char dwellers are worst sufferer in continuing their livelihood when the water level rises abruptly. This uncertain and erratic Phenomenon is ever increasing though the char dwellers do not clearly understands the cause.

### **2.1 Char lands in Bangladesh**

#### **2.1.1 Size of char**

In 1999 the estimated total area covered by chars in Bangladesh was 2,322 square kilometers. During the period of 1989 to 1993, char areas increased in all rivers, except in the upper Meghan. The net increase in char area during this period amounted to 36000 ha which is equivalent to about 25% of total char area during 1984 (ISPAN, 1995).

#### **2.1.2 Char Population.**

The social and economic lives of char dwellers, some 4.3 million people according to the Inventory Survey, **are in large** part determined by the ever-changing nature of the lands upon which they live. This study also demonstrated that char lands were not all alike and the social structures of char people vary somewhat from people in

the rest of Bangladesh. Char people therefore need to be understood within their own context.

In 1992-93 there were some 4.29 million people living in about 3300 mouzas covering 8,400 km<sup>2</sup> in the main river char lands implying about 4.89 million in 2000. Additionally there were probably about 1.5 million people living in coastal chars and there were an unknown number living in or dependent on chars along other rivers, The island chars of the Jamuna and Meghna had relatively high population that in the 1980s increased faster than the overall population rate.

An estimated 5 to 10 million people live on the chars and associated flood-prone areas between 4% and 8% of the Bangladeshi population. The specific area visited by a team was in Sirajganj district which has a char-dwelling population of approximately 4,00,000 people (Ashley, et. al., 2000).

### 2.1.3 Land **Holding**

Lands on chars are used for purposes of settlement as well cultivation. The ISPAN study indicated that of the chars that are not eroded in the first four years of their emergence; over ninety percent are used for either cultivation or settlement by the end of these four years. After seven or eight years, both settlement and agricultural practices are commonly found in these chars.

Reliable data on landholding size is difficult to obtain in the active chars where claims to land may be maintained although it is submerged where occupied land may be technically *khas* land, and where areas used change frequently between water and land and from grassland to crops. Moreover, some studies report operated land while other report total land holding and studies differ in the cut-off points adopted for different land holding categories. The data from different sources indicate a generally much skewed distribution of land in the chars.

According to a Government of Bangladesh National survey conducted in 1996, twenty nine per cent people have no land, 24 per cent have land between 0.01-0.5 ac, 14 per cent have land 0.5-1 acres, 20 percent have land between 1-2.5 acres and 11 per cent have land between 2.5-7.5 acres and only 2 percent have land more than 7.5 acres. In the coastal chars a major difference is apparent between the project settled stable accreted chars of CDSP (CDSP, 1998) and the non-project chars of MES (MES, 1998a). In addition the MES locations were spilled evenly between three with 30% of households having over 1 ha and where under] 2% had less than 1 ha of land.

#### **2.1.4 Topography and Soil.**

Yet the island and attached chars appear to be less productive than adjacent **mainland areas**. The major reasons for this are the relatively less favorable soil conditions in some of the Chars (EGIS, 2000). In some chars there are good prospects for sand mining, which should be properly exploited to benefit from the increasing demand for **sand as a construction material**.

#### **2.2 Livelihood Patterns and Occupation**

Each year a large percentage of the chars get flooded. People in many chars have to leave their homesteads due to floods, which entails a host of problems with regard to transportation, shelter, security and rehabilitation. The flooding is also a problem for those involved in livestock rearing since severe difficulties emerge with respect to shelter, transportation and marketing of the livestock. The island chars are found to be flooded more extensively than the attached chars. A total of 4.29 million people were reported to live in the main river charlands in 1992-93, out of these 1.85 million (43%) live on island and attached chars, and 42% live in the Brahmaputra-Jamuna charlands (Thompson, 2000).

Occupations of char people have been recorded in several surveys. In the char land inventory key informants estimated the percentages of households with different main types of occupations in each mouza (FAP 16/19, 1993). The report shows that throughout the chars, around 40-45% of households farm their own or sharecropped land with day labouring the next most important main household occupation, but the dependence on fishing increases as both a main and secondary occupation moving down to the Padma and the Meghna. Only in the Padma was there a substantial difference in occupation structure between island chars and the char's lands as a whole with fishing being more important in the islands. The survey found that the percentage of farmers, self-employed and beggars fell, some fishers were present in 1975 but none were surveyed in 1984, while students, business people and teachers increased (Carrey, 1985). The data available from the coastal chars indicates very variable occupation patterns between locations, for example most people in some villages depend on fishing or laboring, others are mainly farmers.

For domestic water supply the only options for riverine char people are either river water or ground water using hand tube wells (HTWS), less than 2% use ponds. Most char households now report using hand tubewells in normal circumstance even on island chars. **However in high floods one major problem for char people is obtaining safe**

drinking water: tube well often go underwater, and travel from houses to HTWs is difficult. People who have evacuated from their homes also face difficulties **in accessing** HTWs if they have moved to public lands.

A wide variety of livelihood options traditionally existed in the char **areas** based on people's **asset base**, local resources, knowledge, technology, capacity of the people and institutional support. On the other hand a wide range of risks and associated vulnerability also exists. People do develop and practice a variety of livelihood and risk management strategies (Alam et. al., 2002). Char households had diverse livelihood strategies but they mainly depended on agriculture, Sharecroppers or wage laborers. Landholding distribution appeared skewed distribution. Cultivable areas per person were higher than average in the island and attached chars but crops were very prone to flood damage, lack of irrigation tended to limit winter cultivation: Grasses were an important resource in newly accreted chars in the **Jamuna and Padma**. People living on the chars controlled them but some landlords keep caretakers on the chars. Most grass is used as fodder on-site or cut for sale. There are also substantial amounts of grazing lands for cattle in *Bathan* (open charland used for **raising** cows for milk). Fishing was an important primary and secondary occupation especially on island chars along the Padma and Meghna. Most of the riverine catch of Bangladesh comes from the lower Meghna **and estuarine** areas. They adopted their own indigenous knowledge on the Ganges and Brahmaputra.

### **2.2.1 Agriculture**

Char **lands** can provide high value crops that can be harvested before the first flood peaks occur and social forestry has also been successful in some of the chars. Most of the households in Sirajganj char areas surveyed were dependent on agricultural activities and family income largely constituted by farm income. Local Jute is mainly grown in lowland areas, adjacent to water bodies and major crops. In the medium and highland areas **sugarcane**, millet, wheat, sweet potato, ground nut, chili, khesheri, and other crops are grown. During dry periods very little land is irrigated by small irrigation devices. Due to poor communication facilities and a lack of institutional support the expansion of irrigation facilities is very limited.

In the relatively lower reaches, where land is more fertile, cropping intensity in the char appears to be between 150 and 185, which is **quite similar** to the average figure of 165 for the whole of Bangladesh (BBS, 1997). Agricultural potential in the chars depends on soil quality and flood regime (land level and timing of flooding). A quarter and over a half of land were sandy with consistently more sandy land in the Jamuna. In

general it was found in the Brahmaputra-Jamuna that 70-80% of unprotected mainland was cultivated but more island and attached char mauzas had only 60% or less land cultivated.



Photograph 2.1: Cropping pattern

Only Cultivated land is considered here in the estimation of cropping intensities. Substantial areas in the char land are single cropped. Cropping intensity in the main river chars is comparable to the national average. Cropping intensity does not differ between island and attached chars for a given land level within a river reach. In the Jumuna higher land grows on an average over 2.5 crops in a year while lower land is mainly single cropped. In the Ganges and Padma high medium level land was to be double cropped while lower land averaged almost 1.5 crops a year. However, in the sandier soils of the Ganges and Padma chars a single ("aus") paddy crop is preferred. Irrigated crops are rare in the char except in some Meghna chars. In the Brahmaputra-Jumuna the dominant crop associations were single cropping of Boro, a single millet crop and mixed Aush and Aman paddy.

### 2.2.2 Fisheries

The perennial availability of water in the rivers provides year round opportunities for fishing to many of the char communities. The char Dweller's of Kazipara of Serajganj district is no exception of that At might be expected that the main rivers would be a major source of fish in Bangladesh. Fishing is an important but not dominant economic activity in the char lands. The Government of Bangladesh Department of Fisheries (DOF) estimated that the total catch from the Brahmaputra-Jamuna, Ganges and Padma rivers was about 10,000 ton in 12 months of 1993-1994, this compares with a total official catch for the country as a whole in that year of 1.09 million ton of which 13% came from all rivers and estuaries (DOF, 1999a). The area of rivers is clearly dependent



on the definition and season for example FAP 16/19 (1993 a) estimated about 8,400 km<sup>2</sup> for the total areas of the main river charlands, while Ali (1997) estimated about 2,200 km<sup>2</sup> for the mid 1980s out of a them total **area** of fishing waters of 67,000 km<sup>2</sup>. Unlike most other livelihood assets, access to fish tends to improve in high flood years. Although during the peak flood strong river currents may prevent fishing, fish catches are positively correlated with flood levels. Moreover, during the monsoon **season institutions** governing access to these fisheries tend to be somewhat relaxed and access is more open. In the coastal chars river flooding is unimportant but cyclones have an opposite effect **since** substantial numbers of fishers may die and fishing boats may be destroyed, so the natural asset may be inaccessible.

### 2.2.3 Livestock

Many of the chars have extensive **areas** of grasslands. These **are used** for growing grass for the cattle reared by the people in the chars. A notable feature of substantial areas of accreted char **land is** the extent of grasses in the riverine chars known as *khaisa* or *oreatkin* grass. These grasses **are used as** grazing/cut and carry fodder, for fuel and one of the main house construction **materials** in the chars both as thatch and for house walls. A study by Middlesex University found that only 9 (26%) out of 35 mauzas **in a cluster** of island chars in the Jamuna north of Bhupur lacked extensive area of khaisa (Sultana, et. al, 1996). The use of grasses is mainly controlled by the owner or **claimant** of land, but it is also common for some to be controlled by outsiders and for char people to manage **an area** of grassland as a group. Open access is very **rare**. **In some** areas char people act as caretakers of grassland for powerful people, **and grasses are** harvested for sale through traders for house construction or fodder.

Livestock are a key **asset** for the char people; they not only offer a means of adding value to the grasses that colonize recently accreted land before cultivation is possible, but they are also a **mobile asset in the** face of erosion. Nevertheless livestock are also vulnerable to floods, theft and normal disease hazards, and these problems are more significant in char areas **than mainland** because of the lack of services to counter these threats. Cattle and goats are the main types of livestock in the riverine chars, buffaloes were rare in the riverine char but being more tolerant of saline **grazing are** preferred in the new coastal chars. In peak floods moving cattle to higher **land such as an** embankment is a problem for char households, while storage of fodder and shortage of funds necessitates the sale of an important asset. Livestock ownership may vary considerably between areas and may recover quite fast. It was found that just south of the

Kurigram site that 42% of households owned cattle but average ownership was 3.1 numbers of cattle head per households with cattle, 9% share in cattle. However the same study indicated that goats are relatively more important for poorer households, 25% own goats and 22% share in goats.

#### 2.2.4 Social Activities

It was found that the levels of formal education were low in the Kazipur chars. They adopted their own indigenous knowledge livelihood strategies that were well adapted to the strongly seasonal and uncertain environment. Social structures were critical. Infrastructure was comparatively poor in the island chars, for example fewer schools, and health care facilities and travel to such places was time consuming and expensive. Health worker visits appeared to be less frequent in the Jamuna. Flood shelters had been built through NGO programmes especially in the Brahmaputra-Jamuna. The Jamuna island and attached chars appeared to have fewer boats relative to population. In addition to the major physical risk associated with the river, char dwellers in particular were marginalized from the benefits of mainland Bangladeshi society through their poor communication networks. The livelihoods analysis based on findings in Sirajganj district painted a bleak picture of the life of poor households in the chars and suggests that the combination of physical and social characteristics make the chars one of the poorest parts of Bangladesh, with the people being amongst the most vulnerable. Some of the major issues facing the poor in the chars were as follows: a) Inability to resist physical hazards; b) poor access to essential services; c) inadequate saving and credit options; d) poor access to income enhancing opportunities and services; e) greater vulnerability of Char Dweller's and children. All these vulnerabilities interact in a process that deprives the char people of a decent and secure life. To improve the opportunities for income generation must be seen as one of the central tasks if the general pattern of vulnerabilities was to be altered. The purpose of the CDP should be to turn this vulnerability and others into capabilities at the same time as strengthening the already existing positive factors. Part of the char livelihood strategy is a greater use of social networks in the face of vulnerability than may be evident in mainland areas. Char Dweller's may use their family ties to find shelter as *uthuli* on their relatives land and home is eroded. While Char Dweller's have limited personal assets they help in their household recovery strategy by finding outside work and selling or mortgaging assets including jewelry after floods. The other form of seasonal migration is when men leave to find work elsewhere, this leaves Char Dweller's in a particularly vulnerable situation since they may

have no regular source of income at this time, which appears to be correlated with flood and post-flood situations when char people may be displaced to a shelter with relatives or on embankments and/or when there is a lack of work .

The most important organizational unit of people is the household, and so most of the assets and vulnerabilities considered in this report affect men and Char Dweller's, children and elderly within a household. Nevertheless, **assets are** individually owned and Char Dweller's tend to have very few assets in their name. It is noted that additionally some Char Dweller's are involved in marketing, cutting and processing grasses and catching fish using traps in flooded char land (FAP 16, 1995a). During and after floods Char Dweller's face a considerable burden in keeping these jobs done.

### 2.2.5 Public Services

Service provisions are generally poor in the chars, compared to the main land. It is understood that the provision of public services in chars is difficult and expensive. There are few specific policies or instruments for these areas. Land laws related to the **submergence** and reappearance of land in theory help poor people by allocating land to them or by protecting their interest in land when it re-emerges. In practice the government plays a limited part in this process and one way or other those with power and influence can control and influence the process to the benefit of themselves and their followers.



Photograph 2.2: Group discussion

The study also found that the root causes of poverty in Sirajganj district related to the physical environment of the chars, the lack of income earning and accumulation opportunities, the low status of Char Dweller's and the vulnerability of children. These were closely linked to weak local level service provision by government and NGOs which were themselves linked to the national level rules of the game by which

expenditures and programmes were planned and which were influenced by donor support (Ashley et. al, 2000). The DFID chars rural livelihood programme is looking mainly at local governance issues. It found that UPs distributed (as a government resource distributor) Vulnerable Group Development (VGD) cards and the Food-For-Work (FFW) and Food-For-Education schemes, but these were often misallocated. The relationship between local government (LG) and central government (CG) was still one of patron-client. It secured political popularity at the grassroots level. To further reduce dependency on CG, LG resources and income must be raised and a sense of autonomy over the control and generation of resources must be achieved .

School pupil enrolment and attendance levels are on average lower in the charlands than in the country as a whole due to lower school numbers, poverty and problems of mobility in both monsoon and dry seasons. The (USAID 2010) khasrajbari (Sirajganj) found only two schools in its study area. The study also found only 12% of landless households had one or more men with some formal education and in only 5% of these households did any Char Dweller's have education. Where as 69% of medium-large farms households had at least one educated man and 4% of those households had at least one educated woman. Casual information on ill health is of limited use unless it can be compared with similar national data.

Health facilities within the island char areas are generally scarce, compared with quite a good coverage in the unprotected mainland. This is logical to the extent that thana and union health centre are buildings that cannot be moved and so the investment is risky in island chars that frequently erode and accrete. The infrastructure in the unprotected mainland also has a high risk of eroding in the near future, but is likely to have been built when the river was further away.

Where schools exist in the charlands, they do not differ greatly from the national provision, although there are notably fewer primary schools on island chars and the Brahmaputra-Jamuna appears to be better provisioned than the other rivers. However, infrastructure in itself is not the answer to meeting educational needs.

### **2.3 Hazards due to Climate Change (Floods and Erosion)**

The chars are extremely vulnerable to both erosion and flood hazards. Recent analysis of **time series** satellite **images** indicated that over 99% of the area within the riverbanks of **the Jamuna** river had been char at one time or another during the 27 years period of 1973 to 2000 (EGIS, 2000). The same analysis showed that about 75% of the chars persisted between 1 and 9 years, while only about 10% lasted for 18 years or more

(EGIS, 2000). The effects of riverbank erosion and widening of the river channel on the people living in chars have been significant. An ISPAN (YEAR) study reported that during 1981-2003 a total of 11, 28,439 people were displaced by riverbank erosion. The annual member of displaced persons works out to be 63722. More than half the displacement was along the Jamuna. Food insecurity was high throughout the riverine chars and was higher than in the coastal chars. Most people living on island chars must move home at least once every 6 - 7 years when the braided river channels changed that configuration. Additionally up to 20% of all riverine charland people were displaced by bank erosion during an approximately 11-year period to 1993 (64000 per year). During this period about 10% or about 660,000 were estimated to have permanently left the char land, many destined for the slums of urban areas. In the exceptional 1988 floods virtually all char land, crops and houses were flooded with a third of houses destroyed (Thompson, 2000). The chars are the most flood prone environments in Bangladesh and this has shaped the nature of available natural and physical assets. In extreme events by definitions the entire riverine charlands are inundated. In a peak flood virtually all land in the charlands is underwater, but depressions of flooding were longer downstream in 1988 in the Padma and Meghna. However, in common with cropland, most houses in the charlands were flooded in 1988 and over a third was reported destroyed. Flood impacts include damage to most household physical assets in the chars with average financial losses to homesteads of around Tk. 6,000 in the Jamuna (FAP 16/19 1994), the main components were damage to houses, loss of livestock and loss of trees. More than physical damages, floods affect the lives of char people in similar ways to people in other highly flood prone environments.



Photograph 2.3: River Erosion

The key social aspects of settlement in the chars concern the dynamics of

occupation of accreted lands and relocation when homes and lands are eroded. Sometimes landlords (*jotdars*) gain control of a large accreted char and then recruit tenants (sharecroppers) to cultivate it and may advertise to recruit people. Baqee (1998) has reviewed in detail the situation where settlement of Padma chars is controlled by one or more than one power pole and the resulting conflicts when leaders compete for a char. When both homestead and land are eroded/ submerged year round within the island and attached chars, the affected char people may move as a village (retaining the same village name) or *samaj* (society) to a new location. One social arrangement that may or may not be linked with this type of community relocation is to make a homestead on someone else's land (*uthuli*) without paying rent (Thompson, 2000). A high proportion of housing in the chars is thatched, especially in island chars. Char houses are mainly small and built from locally available grasses, these must be replaced regularly but are adapted to floods and erosion since they can be dismantled and moved. However, floods in the range of 0.5-1m above plinth level tend to result in the total loss of *kutcha* house walls. Loss of walls may permit floods to flow through a house but such houses do not offer safe refuge in a very high flood. Shelter, as a basic capital asset is a critical issue for char people during floods. As flood levels rise more people are forced to leave their homes. It was found that in-house flood depths of about 0.75-1 m a half or more of char households evacuated home (FAP 16/19, 1994). Most people move to relatives' house or to embankments these places may be in the same mauza or much further away. Much of the main river char lands are bounded by flood protection embankments or by roads. In general there are few roads in the char areas since they would be washed away during floods, although unprotected mainland has local earth roads and sometimes surfaced roads. In a few island chars Union Parishads have used food-for-work to make local earth roads, this has been a benefit in terms of a place to shelter during floods rather than as a means of communication.

### 2.3.1 Forest Depletion

In the riverine chars there are few trees compared with mainland areas. New settlers usually plant banana trees when they make their homesteads and if the land appears stable then plant saplings. Unprotected main land also has homestead trees like any other rural areas. The other exception is in the Ganges chars in Rajshahi District where the Forest Department had by 1995 planted trees on some 520 ha of chars and has also experimented with agro-forestry through "shelter belts". The Ganges char is one of the main potential areas for a forestation (DOF, 1996). In this region since they are relatively stable and had the potential to benefit people being settled there on *khas* land

through social forestry. However, the implications for planting more char areas with trees on monsoon and high flood are not known. This ever increasing trends of resettlement of the poor people depleting the forest and thus increasing the overall carbon signature. Country like Bangladesh facing acute exposure will suffer disproportionately to others. It may be mentioned that 184 nations will be affected in four areas: health, weather disasters, loss of human habitat through desertification.

### 2.3.2 Food **Insecurity**

Food insecurity, to whatever extent, is prevailing in the country, mostly affects the segment of population who are mostly dependent on the agricultural for their livelihood. Hunger and malnutrition are the products of food insecurity as outcome of several factors. Price hike of essentials, seasonal food insecurity, increasing price of agricultural inputs, climate related factors led to the food insecurity to a large part of population in Bangladesh who are mainly the rural poor farmers. Different governments at many crisis periods have been faced with the challenges to ensure food security for the poor people of the country. Diverse inefficiencies within the systems have led to the failure of the range of measures that have been adopted at various times for creating defense for the people against the crisis. Food crisis and price escalation hits the poor and the vulnerable the hardest, as a large percentage of their income, in fact, is spent on food. Bangladesh has been experiencing rising trend of inflation since early 2007, particularly in case of food grain. Even though the recent price hike is some how affect of global economic recession and consequently price spiraling of the principle food grain, however most often local market does not adjust price with international price decrease. Such less committed profit based market mechanisms increase the sufferings of the poor. Consequently, the poor are deprive from their right of access to food.

Farmers in the remote rural areas are the most vulnerable to the price hike as they are deprived from fair price for their products due to various inefficiencies prevailing in the agricultural product market. Several times government has tried to adopt some measures to ensure fair price to the farmers including procurement of food grain from farmers at a price which would provide them a certain level of profit over the production cost. But, the procurement drives has sometimes criticized for inconsistencies and political biasness. In many cases the real farmers did not get the real price and are being forced to sell their production to the middlemen, eventually the middlemen got the advantage of government's procurement action. Food price monitoring is another safeguard measure of the government against food prices. Along with the government some private institutions are involved in monitoring the food prices in the city markets. Nevertheless,

the mechanism in some cases does not produce effective result due to irregularity. Food grain price has shocked the world to a new level of awareness. And every country individually or regionally has been developing its own safety net to face the looming crisis. In the circumstances, Bangladesh should be prepared to fight the crisis on its own, while at the **same** time being a food importing country increase **its bargaining** capacity with the rich and food surplus countries. No other crisis that hit rural Bangladesh every year is seasonal food insecurity. In the northern part of Bangladesh, a severe food crisis occurs every year which is known as Monga. During the pre-harvest period this periodic food shortage occurs, which is related to land tenure **arrangements**, the traditional system of subsistence agriculture and the exploitative loan system of the agricultural credit market. In the lean period (Bengali month Kartik) northern districts of Kurigram, Lalmonirhat, Nilphamari, Rangpur, Gaibandha, Bogra and Sirajganj experience widespread unemployment in the agricultural fields (Thomson,2000).

The widespread unemployment during this lean period and due to the unavailability of alternative income opportunities, the people's purchasing capacity decrease to a critical level. In addition, inadequate supply of food **grain** in the market and bare food stock in the households forced them to stay hungry.

The above mentioned human induced crisis occasionally causes many unprecedented **natural** events in the form of cyclones, flood, and drought which are likely to occur and worsen the situation of food insecurity in a more convoluted form as a result of **climate** change. The impacts of climate change on agriculture food production are global concerns and for that matter Bangladesh, where lives and livelihoods depend mainly on agriculture, are exposed to a greater danger as the country is one as the top most vulnerable countries due to climate change.

In Bangladesh, the overall impact of climate change on agriculture production will be negative. Impacts of climate change such as temperature extremes, drought, changing rainfall pattern, cyclone, flood and salinity **intrusion** are declining crop yields every year and the arable land has already decreased to many fold since independent which, mostly threatening the food security. Moreover, variability in climatic factors is contributing to increase pests, insects and microorganisms in agriculture, resulting huge reduction in crop production. **The impact of these changes on the live of the people, economy, infrastructure, agriculture and food security are beginning to unfold as evidenced by cyclone Sidr and Aila. In response** to the flood, cyclone and other climatic hazards governments take post-hazards initiatives in the form of relief, cloth distribution, seed distribution, fertilizer and other agriculture raw materials distribution. These are essential,



but not enough for long term food security. Moreover, corruption and irregularities in the relief distribution make affected people's life more problematic.

The government here should act as a pioneer for taking necessary actions along with Non Government Organizations (NGOs) to face the challenges of food security. The agriculture department must be given top priority to develop climate resistant crop varieties and technology for flood affected, munga and costal area. Therefore, agriculture research should be geared up especially plant and animal breeding research. Moreover, Government and NGOs should promote practices to increase homestead food production for char land dwellers, homestead vegetable production in drought-prone areas. In face of climate change community based adaptation programmes should be prioritized both in policy and practice. The weather forecasting early warning system should be developed to an international standard so that people can be informed about the upcoming disaster whether flood or cyclone and the farmers can take immediate actions to save their crop and properties from the climatic hazards (Thomson, 2000).

## **2.4 Climate change projections**

### **2.4.1 Sea level rise**

Another critical variable that determines the vulnerability of Bangladesh to climate change impacts is the magnitude of sea level rise. There is no specific regional scenario for net sea level rise, in part because the Ganges-Brahmaputra delta is still active and the morphology highly dynamic. Literature suggests that the coastal lands are receiving additional sediments due to tidal influence, while there are parts where land is subsiding due to tectonic activities (Huq et al. 1996). Since the landform is constituted by sediment decomposition, compaction of sediment may also play a role in defining net change in sea level along the coastal zone and char areas. A review of the literature and of expert opinion suggests that sediment loading may cancel out the effect of compaction and subsidence, so that net sea level rise may be assumed. The Bangladesh country study put the range at 30-100 cm by 2100, while the IPCC Third Assessment gives a global average **range** with slightly lower values of 9 to 88 cm. Higher mean sea levels are likely to compound the enhanced storm surges expected to result from cyclones with higher intensity. Even in non cyclone situations, higher mean sea levels are going to increase problems of coastal and char inundation and salinization in the low lying deltaic coast and chars.

The climate models all estimate a steady **increase** in temperatures for Bangladesh, with little inter-model variance.<sup>6</sup> somewhat more warming is estimated for winter than for

summer. With regard to precipitation - whether there is an increase or decrease under climate change is a critical factor in estimating how climate change will affect Bangladesh, given the country's extreme vulnerability to water related disasters. The key is what happens during the monsoon. More than 80% of the 2,300 mm of annual precipitation that falls on Bangladesh comes during the monsoon period (Smith et al., 1998).

#### **2.4.2. Change in frequency and intensity of cyclones**

Bangladesh currently has extreme vulnerability to cyclones, both on account of its somewhat unique location and topography (that creates an inverted funnel effect), and because of the low (though growing) capacity of its society and institutions to cope with such extreme events in char areas. Cyclones originate in the deep Indian Ocean and track through the Bay of Bengal where the shallow waters contribute to huge tidal surges when cyclones make landfall. Existing literature records storm surges in the range of 1.5 to 9 meters, and some sources even cite particular cyclones as having resulted in surges almost 15 m in height. A partial listing of major cyclones and accompanying surge heights is given in Table 2. The intense precipitation that usually accompanies the cyclone only adds to the damage through inland and riverine flooding. A cyclone in 1970 resulted in close to 300,000 deaths, and another, in 1991 led to the loss of 138,000 lives, although in recent years greater success in disaster management has significantly reduced the lives lost (World Bank 2000) in char areas. Nevertheless, the potential for economic and infrastructural damage remains very significant in char areas.

### **2.5 Theoretical perspectives on vulnerability and adaptive capacity**

#### **2.5.1 Rural labour markets**

Char is a very remote area. There are very limited and seasonal work opportunities due to floods. Therefore, a question arises as to how many of the char people are actually unemployed? Is there any scope to encourage out-migration? Are people going to the nearest upazila or town for work in the lean period or year round? Are there any differences in wages for men and Char Dweller's and between seasons? Are skilled and educated laborers going abroad for work? How do they send remittances? How are they using remittances- house building, buying new land, purchasing agricultural inputs or paying for better education for their children? What are the possible scopes to create more employment opportunities in the char? People living in distant char land endure very insecure livelihoods because river erosion causes great vulnerability in terms

of loss of cultivated land, homestead and assets, and disrupts roads and communication and marketing of agricultural products. But in attached char, they are more or less stable. The main problems are the lack of adequate support from the local government regarding roads and telecommunications, electricity, health facilities, employment opportunities, and the availability of educational institutions and that make their life more difficult to adopt with persistent hazards they face.

There exists an increasing amount of literature about the operational concept of social and economic vulnerability to environmental risk. Generally, vulnerability is seen as the outcome of a mixture of environmental, social, cultural, institutional and economic structures and processes related to poverty and (health) risk, not a phenomenon related to environmental risk only. An extensive overview and discussion of recent theoretical and applied research on vulnerability and adaptive capacity in flood-prone areas is provided by few (2003). Definitions of vulnerability focus on risk and risk exposure on the one hand and coping and adaptation mechanisms on the other. Besides risk exposure, adaptive capacity is seen as a key component of the concept of vulnerability. Empirical studies focus more and more on variations in both exposures to natural hazards and people's capacity to cope with these hazards.

Adaptive capacity is considered a process of adaptation (over time) to structural and/or incidental sources of environmental stress, consisting of distinct social, economic, technological, institutional and cultural adaptive mechanisms (e.g. Cardona, 2001). Social mechanisms refer, for example, to social networks of relatives and neighbors, economic mechanisms to livelihood diversification or savings, technological mechanisms to technical measures to prevent flooding such as embankments, institutional mechanisms to (in)formal political-organizational structures and associated collective action to ameliorate vulnerability (including for instance access to productive assets or community micro-credit systems) and cultural mechanisms to perceptions and beliefs about the nature and avoidance of flooding.

Another distinctive feature of the concept of vulnerability is the level or scale of analysis. Variation in social and economic vulnerability to environmental risk can, for example, be explained at the level of the individual household or the community. In some studies, even national indicators are compiled and argues that individual vulnerability is determined by other factors than collective (community) vulnerability, but uses similar indicators for both levels of analysis (e.g. income (GDP) either measured at individual household level or at the level of a region or country). In this paper, we also distinguish explicitly between individual (household) and collective (community) vulnerability and

we use similar indicators as the ones proposed in order to establish associations between risk exposure, poverty and what we label as *ex ante* and *ex post* adaptive coping mechanisms. The relationship between vulnerability and poverty is not as straightforward as expected. The poor are indeed more exposed to risks of flooding, but they that they are therefore also more likely than the wealthy to suffer when flooding strikes exposure to risk and the adaptive capacity to risk (Brouwer, et al, 2006); being exposed to the risk or afterwards (e.g. insurance).

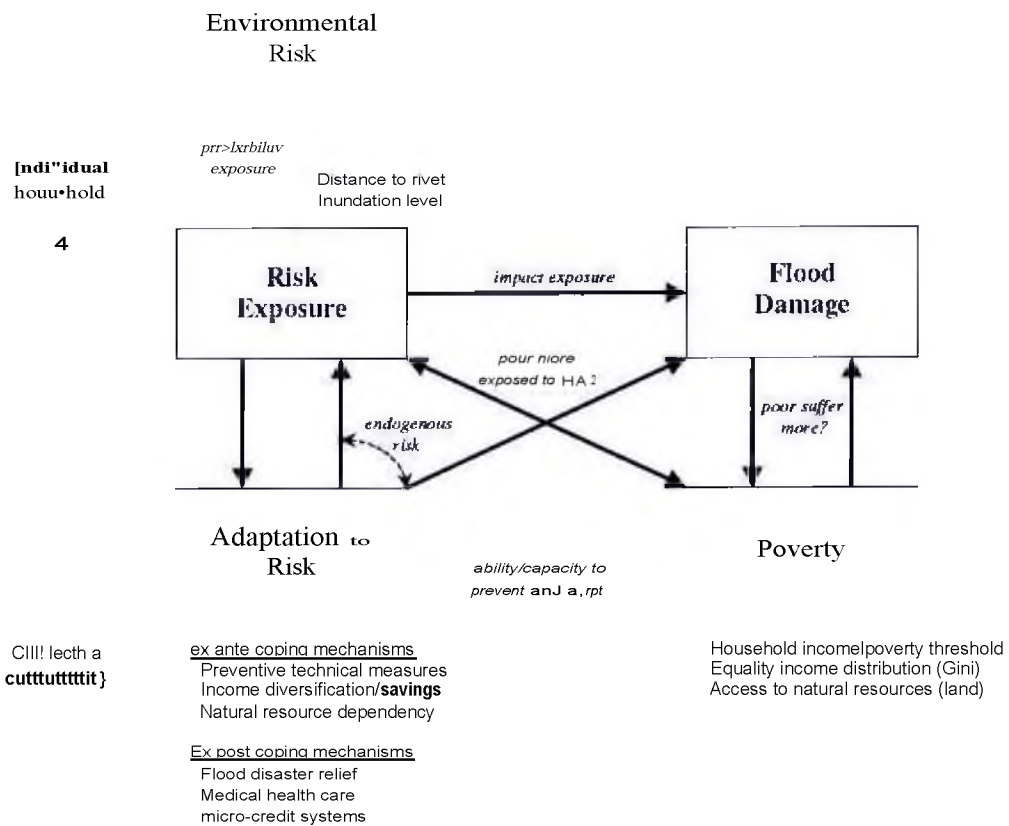


Figure 2.1 Analytical frameworks underlying the case study (Funtowicz *et al*, 1992)

Here, we subsume the endogenous component of risk under adaptation, and distinguish explicitly between *ex ante* and *ex post* coping mechanisms at individual household and collective community level. We furthermore distinguish explicitly between the likelihood of being struck by flooding (probability of exposure) and the impact of flooding

(measured through damage cost). These are considered two separate dimensions of the concept of risk, where risk is defined as the (objective or subjective) probability of reaching a future state or outcome and the expected consequences of this state or outcome (e.g. Costanza, 1994). Here, we refrain from attaching probabilities to flooding (flooding being an annual event) and simply measure (i) the probability of risk exposure through the distance (in kilometres) people live to the river at community level (the closer to the river, the higher the probability of flooding), (ii) the state or condition of risk exposure through inundation depth (in feet) at individual household level, and (iii) the consequence of risk exposure through economic damage cost (local currency converted to US\$) when the flooding occurs at individual household level. Poverty is both an important determinant of (endogenous) environmental risk - and hence directly of socio-economic vulnerability - and an important constraint of adaptive capacity. Poorer people tend to be more (often) exposed to environmental risk than wealthy people. The latter are furthermore able to take protective measures or are able to avoid certain environmental (health) risks, i.e. the endogenous component of risk. Conventional poverty indicators (e.g. Blackwood and Lynch, 1994) used in this study include annual household income compared to the official poverty threshold value calculated by the Bangladesh Bureau of Statistics, income distribution at community level and household access to and ownership of natural resources, most importantly in this case study land for crop cultivation.

## **2.6 Ongoing projects on livelihood adaptation.**

DFDI (DFID, 2007) aims to "mainstream" adaptation activities into its development assistance. Mainstreaming involves screening all development projects to assess and address climate risks. The screening prioritizes key planned and ongoing activities according to the extent to which they are "at risk" from climate variability and climate change and the extent to which they present opportunities for reducing risk and vulnerability. Based on this assessment, recommendations are made for integrating disaster risk reduction and climate change adaptation within program activities. These recommendations are then assessed for impact, cost-effectiveness, and feasibility. The pilot program for mainstreaming began in Bangladesh in 2006.

It is important to note that while the CDMP (DFID, 2007) takes steps to include minority and excluded groups in the community participation process, in practice, this does not equal village level participation. Rather, village representatives are invited to participate at the level of local or district government. Although an early review in 19974 raised

concerns that CDMP was not paying sufficient attention to gender issues, a more recent review suggests that this has since been addressed.

The Kyoto Protocol Adaptation Fund should become the main channel for future adaptation funding. This entity would be responsible for ensuring that Char Dweller's leadership is central in decision-making around how funds are disbursed and used as well as by which projects are implemented, monitored and evaluated. It would also be responsible for ensuring that adaptation funds are meeting the needs of poor and marginalized Char Dweller's affected by climate change and should coordinate closely with the multi-stakeholder committee's in-country damaging effects of climate change, it will continue to be one component of adaptation funding. Therefore, it is critical that these bilateral and multilateral agencies climate-proof their work.

In Bangladesh (Unnayan Parishad, 2007) some pilot sites are selected to learn the practical measures and mitigation of flood risk for Char Dweller's as well as a message are

- Establish a conservation- integrated home garden development.
- Establish a highland farm that contributes towards sustainable management of resources including biodiversity.
- Develop the banks of the stream that runs through their land.
- Provision of Homestead for reducing flood risk.

IFAD's (IFAD, 2007) operations in Bangladesh over the next five years will support five separate Sub programmers. Project activities will improve income-generating opportunities for rural people living in severe poverty , who have low food security and lack basic assets such as land . The main aim of the IFAD program is:

- **Making agricultural technologies more readily available to small-scale farmers to boost rural growth and provide people with a secure and adequate food supply and with opportunities for income and employment.**
- **Improving access to markets and financial services for rural small entrepreneurs.**
- **Introducing innovations in infrastructure development, such as transport and access to markets and to water, to benefit the poorest areas.**
- **Improving rural poor people's access to common property resources such as inland fisheries and public land.**
- **Increasing Char Dweller's's access to economic opportunities , continuing the progress already made towards the empowerment of Char Dweller's in**

the country.



Photograph 2.4: Household hold kitchen garden

IFAD supports reforms in key policy areas, including:

- **Improvements in agricultural extension and research.**
- Regulation required for improved access to inland fisheries.
- Regulation of rural markets.
- Reforms in the regulatory framework for rural finance.

CLP (DFID, 2007) program already targets vulnerability to a broad **range** of shocks and stresses and actively considers a range of current climate risks within its works. Their all stakeholder are Char Dweller's. For example, livelihood promotion targets climate resilient activities, including poultry rearing to promote mobility, mobile identification cards, and flood compensation schemes. At household level the project is facilitating the rising of homesteads onto mud banks above the 10 year flood level.

Impacts of climate change on food production and food security are global concerns, but they represent a particular threat for Bangladesh. Agriculture is already under pressure mainly due to an increase in demand for food, as well as to depletion of land and water resources, The prospects of global climate change make this problem a priority for Bangladesh.

By 2050, though monsoon rainfall is expected to increase by 28%, intermittent dry and wet spells can not be ruled out. High intense rainfall would result in increased flooding and sedimentation of floodplains, making them less productive. The Comprehensive Disaster Management Programme (CDMP) recognizes the risks associated with climate

variability and change and the current lack of capacity in assessing and managing long-term climate risks in Bangladesh. Component 4b of the CDMP seeks to establish an integrated approach to managing climate risks at national and local levels. Under this Component, efforts were undertaken in partnership with the Food and Agriculture Organization of the United Nations (FAO, 2006) to implement activities designed to promote livelihood adaptation and reduce vulnerability to climate change, particularly amongst Char Dweller's and poor communities who have the lowest capacity to adapt. But for particular Char Dweller's livelihood options strategy is still absent.

The core challenge is to prepare an adaptation options for the different govt. and not govt. sector and possible strategic interventions in and across sectors, so that a comprehensive action plan of adaptation to address the vulnerability to the impacts of climate change, including variability can be developed which is under active consideration of the responsible authority. Despite the recognition of adverse climate change impact scenarios, Char Dweller's's livelihood adaptation has not been adequately addressed in the research area yet. There is no intervention towards implementing appropriate policies and programmes to integrate climate change concerns into development sector in the research area.



## CHAPTER 3 METHODOLOGY

### 3.1 Process of the methodology

The methodology aims at a holistic analysis of the causes and impacts of climate variability and the local perceptions climate related hazards. By the local adaptation practices identification will help to minimize the impact of flood through participatory rural appraisal approaches. The overall report writing is sequentially developed by following step

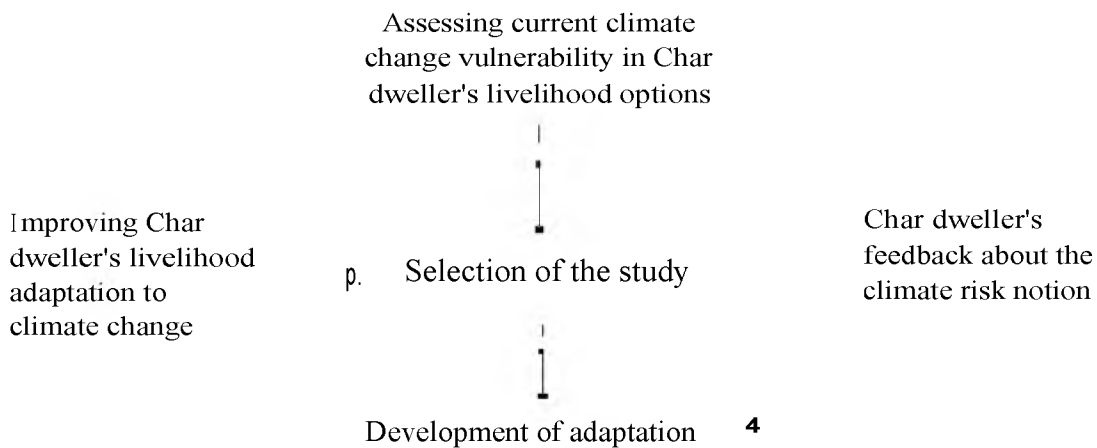


Fig 3.1: Identification of climate risk

Also it will be identified what will be perfect realization approaches for the community with the current climate change condition. It may help for the institutions who are working in that community.

### 3.2. Select the study area

The flood-prone locations are primarily identified based on a secondary literature review and finally selected Sirajganj districts in mid point of Bangladesh. The pilot study area is chosen because the area is:

- Primarily flood prone (moderate to severe) and
- Various profession of Char Dweller's availability in the research area.

Then start the field observation of adaptation options to current vulnerability and future climate risks.

### **3.2.1 Establish communication with the community and local institution.**

Go the Upzaila office for collecting the baseline map and other demographical information. Collect the general concept of hazard condition in the study area and livelihood options, institutional contribution in the research area. And finalize the specific area for study of the research.

### **3.2.2. Method or tools used.**

Participatory Rapid Appraisal (PRA) tool is used in field research. I was conducted with six PRA sessions in three villages. I have been facilitated these PRA SESSIONS. Char Dweller's of the respective village took part in the session. The core activities of PRA for building consensus among the different concerned stakeholders specially to Char Dweller's on identified actions (interventions) relevant to hazard management and mitigation.

### **3.3 Study design**

This was a descriptive study by using primary and secondary data. Different published and **unpublished** reports were consulted to examine the char dweller's adaptation to Climate Change.

### **3.4 Study period**

Three-month period was the study **duration**.

### **3.5 Study population**

The people live in the Kazipara , Sirajgonj char area of Bangladesh.

### **3.6 Methods of data collection**

Both qualitative and quantitative (Questionnaire) approaches (by using mostly secondary data and some of primary) were used for this study. Secondary data sources included- study reports, annual reports of different NGOs, Reports of donor agencies, and review articles on char area livelihood patterns, published and unpublished reports from government and private organizations and from different journals.

### **3.7 Participants and Settings**

This cross sectional survey type study was carried with a statistically determined sample of 100 affected people. Only married men and Char Dweller's were included as the sample. This study was carried out at char regions in Bangladesh. Applying two-stage sampling technique one sub-district (sadar thana or main sub-district) was selected from 8 sub-districts from the districts. At the second stage, four villages were randomly selected as the study area. From each village, 25 participants were interviewed conveniently.

### **3.8 Data Collection Procedure**

The study was conducted with pre-tested a semi-structured questionnaire. The questionnaire had three parts: part one included questionnaire on background characteristics, part two was included respondents' livelihood pattern for char adaptation for climate change and part three was included the hazard respondents' faced for climate change. Prior to interview, four local interviewers having graduation were recruited to interview the participants with necessary conceptual and contextual understanding through intensive training. The interviewers were carrying out interview on one to one basis at participant's house. None but the participant was present at the place of interview. The interviewers cross checked the questionnaire so that relevant questions were not over looked during the interview. If any inconsistency arose, the respective interviewers were recollected the information at the next day so as to reduce the inconsistency. To provide necessary conceptual and systematic support, two supervisors were monitor the interview and cross checking process regularly. During the field work, ethical procedure was strictly maintained through taking written informed consent from each participant, stopping interview at the middle of interview due to unwillingness and remaining confidential. To interview 50 respondents, altogether 60 respondents were approached indicating 90.90% success rate. In place of participant's name, a unique identification number was used

so that participant's information remains confidential. On an average, each interview was lasted for 30 minutes while each interviewer interviewed 30 participants.

### 3.9 Measurements

To examine the effect of climate change on existing hazards in Char areas, information related to socioeconomic status of the respondents were collected.

Socioeconomic status included- age, sex, occupation, income, pattern of life etc.

To assess the impact of climate change on Livelihood pattern of Char Dwellers, respondents were asked about crop pattern in those areas, mode of transport, farming and non-farming options, Health facilities etc

To estimate how char dwellers can adapt their livelihood to Climate change in future course of actions, they were asked about their future plan, Social capital such as- opportunities to save money, Providing Infrastructure such as a safe place to live, a clean water supply and sanitary latrines, tracking the monthly income and expenditure habits of all of its core beneficiary households.

#### List of Variables

Indicators	Variables
	- Age
	- Sex
	- Religion
• Socio-Demographic	- Marital status
	- Education
	- Occupation
	- Number of household members
• Household assets	- Number of earning members
	- Number of dependent members
	- Household expenditure on food
• Household expenditure	- Household expenditure on education
	- Transport cost
	- Crop pattern in those areas
• Climate change on Livelihood pattern	- Mode of transport
	- Farming and non-farming options
	- Health facilities
	- Opportunities to save money
	- Safe place to live
• Adapt their livelihood to Climate change	- Clean water supply
	- Sanitary latrines
	- Tracking the monthly income
	- Expenditure habits

### **3.10 Data analysis**

The findings from literatures review were compiled in the result section. Analysis was done under the theme of *i) Socioeconomic conditions of the char dwellers ii) impact of climate change on Livelihood pattern of Char Dwellers iii) the effect of climate change on existing hazards on Char area and iv) how char dwellers can adapt their livelihood to Climate change in future course of actions.*

## CHAPTER 4 RESULTS

### **4.1 Socioeconomics status of char dwellers**

Average age of the respondents was 35-53 years and most of them (48%) were illiterate, 28% had primary education, 17% had secondary education and only 3% had higher education. Fifty two percent of the respondents reported that agriculture was their main occupation, 24% were labourers and only 4% were students. They were also involved in subsidiary occupation. Twenty percent had subsidiary occupation, 4% of them had agriculture land, 8% petty business, 2% had horse cart and wage labour as their occupation, 6% had rickshaw pulling. Majority of the were Muslim. The average family size of the respondents was 5.5. Most of the family members of respondent were illiterate (37%), 28% were able to sign only and 35% had primary and above education. Thirty six percent of the respondents were male and 27% were female wage labourers among the working members of those households. Table I Socioeconomic profile, employment situation, income and expenditure of the study area respondents were explained. Slightly more than half (68%) of the respondents spend less than 2000taka for food per month. Less than 5% respondents spend more than 200 taka for education.

Table 4.1: Socio- demographic characteristics of the respondents

Variables	N	%
Age		
<30	4	8
30-45	34	68
45-60	12	24
Sex		
Male	30	60
Female	20	40
Religion		
Islam	46	92
Hindu	3	6
Other	1	2
Marital status		
-married	37	74
-unmarried	10	20
-others	3	6
Variables	N	%
Education		
-illiterate,	24	48
-primary education	14	28
-secondary education	8	17
- higher education	2	3
Occupation		
Agriculture	26	52
Labourers	12	24
Students	2	4
<i>Subsidiary occupation (20%)</i>	10	20
-agriculture land	2	4
-business	4	8
-horse cart	1	2
-rickshaw pulling	3	6
Household expenditure on food		
<2000tk	34	68
2001-4000	13	26
>4000	3	6
Household expenditure on education		
<100	41	82
101-200	7	14
>200	2	4
<b>Total</b>	<b>50</b>	<b>100%</b>

The respondents were asked about their household **assets** (e.g. had TV, radio, fan, furniture etc) (Table-2). It was found that most of the respondents did not have TV (94%). On the other hand half of them had radio. Only one-fourth of them had fan and 7 of 10 respondents had furniture. Slightly more than 60% respondents had family members between 5-8 and about 60% family had one earning member.

Table 4.2: Distribution of household assets of the respondents

<b>Variables</b>	<b>N</b>	<b>%</b>
Household assets		
-TV		
yes	3	6
no	47	94
-radio		
Yes	25	50
No	25	50
-fan		
Yes	12	24
No	38	76
-furniture		
Yes	38	76
no	12	24
Number of household members		
<4		
5-8	11	22
>8	33	66
	6	12
Number of earning members		
=1	29	58
1-2	14	28
>=3	7	14
Number of dependent members		
<2	11	22
3-5	25	50
>=6	14	28
<b>Total</b>	<b>50</b>	<b>100%</b>

#### 4.2 Effect of climate Change on existing hazards on Char areas

It was found from the secondary data that sea level rise for higher temperature would cause huge damage on the char dwellers living. The respondents were asked about the knowledge of sea level rise and high temperature and flood and sediment carried out by flood water (table 3). Only 20% respondent had knowledge on sea level rise and about same percentage (24%) of respondent knew about high temperature. Majority of the respondents mentioned (78%) flood as natural process. Most of them (80%) knew about the sediment and benefit of sediments after flood.



Table 4.3: Respondents knowledge on sea level rise and high temperature and flood and sediment carried out b flood water

Variables	N	
knowledge on		
sea level rise		
-yes	10	20
-no	40	80
high temperature		
-yes	12	24
-no	38	72
cause of flood is		
-climate change	4	8
-high temperature	3	6
-sea level rise	4	8
-natural process	39	78
sediment carried out by flood water		
-yes	40	80
-no	10	20
Is this sediment useful		
-yes	40	80
-no	10	20
<b>Total</b>	<b>50</b>	<b>100%</b>

To find out the respondents' practice for overcoming the natural disaster, they were asked about the natural disasters names, methods follow to overcome the natural disaster in char areas, methods for protection from disease. It was found that majority of them knew the name of the natural disasters but in different terms (such as- they called "Ban" for flood, "Deowa" for rain etc). To overcome the natural disaster in char areas they change crop patterns with seasons, select time of cultivation after prediction of natural distruster and to survive and earn livelihood they also selected occupation with season (Table 4). Minority of them (30-40%) visited health centre while sick, had saline for diarrhea and use sanitary latrine.

Table 4.4: Practice of respondents to overcome the natural disaster

Variables	N	%
Practice of the respondents to overcome the natural disaster		
Name of the natural disasters in char areas*		
-Flood	48(50)	96
-Draught/no rain	48(50)	96
-Enhance monsoon	50(50)	100
Methods follow to overcome the natural disaster in char areas*		
-crop pattern change	40(50)	80
-selection of time of cultivation	42(50)	84
-selection of occupation with season	45(50)	90
Methods followed for protection from disease*		
-Use sanitary latrine	15(50)	30
-Have saline for diarrhea	20(50)	40
-Visit health centre while sick	20(50)	40
Multiple responses*		

#### 4.3 Impact of climate change on Livelihood pattern of Char Dwellers

To observe the impact of climate change on Livelihood pattern of Char Dwellers both the primary and secondary data were considered. The primary data were collected by questionnaire and secondary data were collected from literature review.

Primary data showed in table 5 the livelihood pattern of the respondents of char dwellers. The respondents tried to cultivate crop with the season or climate. They cultivate mostly Boro and Rabi paddy during January to June. The labourers had busy time in Boro and Rabi seasons. These seasons covered the period from January to June (January for planting, March for weeding Boro paddy and May-June for harvesting Boro paddy). They also cultivated vegetables, pulse and some time jute. Mostly they used boat (90%) followed by rickshaw (40%), Van (30%) and bus (10%).

Table 4.5: Livelihood pattern of the respondents

	N	%
Crop pattern in those areas*		
- Boro	40 (50)	80
-Rabi	40(50)	80
- Jute	10(50)	20
- pulse	20(50)	40
- Home surrounding kitchen	45 (50)	90
Mode of transport*		
-boat	45 (50)	90
-rickshaw	20(50)	40
-bus	5 (50)	10
-Van	15(50)	30
-others (bicycle, motorbike)	2(50)	4
Multiple responses*		

From secondary data (EGIS 2000) it was found that in ranking the risks from climate change, the scoring (high, medium, or low) for all four factors was considered, but the most weight was placed on the certainty of impact. Impacts that are most certain, most severe, and most likely to become severe in the first half of the 21<sup>st</sup> century are ranked the highest. The results of this analysis are summarized in Table 6.

Table 4.6: Priority ranking of climate change risks for Bangladesh char areas

Resource/ranking	Certainty of impact	Timing of impact	Severity of impacts	importance of resource
Water resources (flooding)	Medium	High	High	High
Char/Coastal resources	High	Low	Low	Low
Human health	Low	Low	Low	High
Agriculture	Medium	Medium	Medium	Medium

Water resources are ranked as the greatest concern because flooding is already an important issue for the country. Increased flooding would no doubt be significant. Since small changes in runoff can substantially increase flooding, it is expected that increased flooding will be noticeable in the next few decades. The combination of increased glacial melt, which is highly likely, and increased monsoon intensity, which appears likely, makes increased flooding also likely.

To calculate the impact of climate change on respondents they were asked about the impact of flood (Table7). Most of the respondents mentioned reduced their livelihood

options (80%), suffer from different types of diseases (80%), earning loss (90%), need to go for loan with high interest (90%), lost cattle and farm animals (90%). They also mentioned that they need to migrate (90%), loss of their and cattle' food (80%), become poor (80%) and interrupt education (96%).

Table 4.7: Distribution of impacts of flood on respondents

	N	%
<b>Impact of flood*</b>		
- reduced their livelihood option	40 (50)	80
-suffer from different types of diseases	40(50)	80
- earning loss	45(50)	90
- need to go for loan with high interest	30(50)	60
-lost cattle and farm animals	45(50)	90
-Need to migrate	45(50)	90
-loss of their and cattle food	40(50)	80
-become poor	40(50)	80
-interrupt education	48(50)	96
<b>Multiple responses*</b>		

#### 4.4 Adaptation of the char dwellers livelihood to Climate change in future course of actions

Adaption of the char dwellers livelihood to Climate change in future course of actions is one of the objectives of this study. To find out the options the respondents were asked about their opinion. The respondents mostly used pond and river water (42%) for daily uses. For drinking purposes they also used (40%) tube well. Only one-fourth of the respondents used sanitary latrine. They mentioned the options in table 8 to adapt with the climate change. They changed their crop pattern (80%), need place to stay during flood, cyclone etc natural disasters (80%), need high land to preserve livestock (86%), temporary income options needed (70%), need clean water supply (90%).

Table 4.8: Adaption options of the respondents to the livelihood to Climate change

<b>Variables</b>	<b>N</b>	<b>%</b>
<b>Water supply</b>		
-Pond & River	21	42
-Tube well	20	40
-other	9	18
<b>Types of latrine</b>		
-Sanitary	12	24
-Pit	18	36
-Kacha	17	24
-Others	3	6
<b>Total</b>	<b>50</b>	<b>100%</b>
<b>Adaption options*</b>		
- changed their crop pattern	40 (50)	80
-need place to stay during flood, cyclone etc natural disasters	40 (50)	80
-need high land to preserve livestock	43 (50)	86
-temporary income options needed	35 (50)	70
-need clean water supply	45 (50)	90
<b>Multiple responses*</b>		

## CHAPTER 5 DISCUSSION

Bangladesh's Char/Coastal resources are ranked as next most vulnerable because the country exists mainly in a delta with most of its population and resources at low elevations and indeed it is more certain than increased flooding. Since increases in flooding and sea level rise are quite likely, these two risks are "clustered" together. In this study the socio-demographic status of the char dwellers, the effect of climate change on existing hazards in Char areas, the impact of climate change on livelihood pattern of char dwellers and how char dwellers can adapt their livelihood to Climate change in future course of actions were examined. Ideally, the char from Kazipara upazilla are still having better facilities than many others char where a numbers of NGO's and GO's are working to enhance the capacity of char livelihood. For these purposes, 50 participants were interviewed by using a pre tested questionnaire.

### **5.1. Socio-demographic status of char dwellers**

Average age of the respondents was 35-53 years and slightly less than half (48%) were illiterate only 3% had higher education. About half (52%) of the respondents reported that agriculture was their main occupation. There were labourers (24%) and students (4%) as well. They were also involved in subsidiary occupation such as petty business (8%), horse cart (2%) and rickshaw pulling (6%). According to Ashley and others (2000) school pupil enrolment and attendance levels are on average lower in the char lands than in the country as a whole due to lower school numbers, poverty and problems of mobility in both monsoon and dry seasons. The (USAID 2010) khasrajbari (Sirajganj) found only two schools in its study area. The study also found only 12% of landless households had one or more men with some formal education and in only 5% of these households did any Char Dweller's have education. Where as 69% of medium-large farms households had at least one educated man and 4% of those households had at least one educated woman. Casual information on ill health is of limited use unless it can be compared with similar national data. Majority of the respondents of this study were Muslim. The average family size of the respondents was 5.5. One-fifth of the respondents were male and about 30% were female wage labourers among the working members of those households. Slightly more than half (68%) of the respondents spend less than 2000taka for food per month and only less than 5% of them spend more than 200 taka for education. According to CDSP (1996) and Thompson (2000), floodplain

residents living in villages that are situated further away from the river have higher income levels. Interestingly, a significant negative relationship is found between distance and income distribution. Villages situated further away from the river have more equal income distributions. There is significant negative relationship between char dwellers and income. The lower incomes suffer higher inundation levels and are hence indeed more exposed to flood risks. The same significant negative relationship is also found between inundation depth and land ownership. In this study most of the respondents did not have TV (94%). On the other hand half of them had radio. Slightly more than 60% respondents had family members between 5-8 and had one earning member. These findings commensurate with national data on char dwellers (Roy et al., 2006; Thompson, 2000 and BBS, 1997).

## 5.2. Effect of climate Change on existing hazards on Char areas

It was found from the secondary data that sea level rise for higher temperature would cause huge damage on the char dwellers living. The respondents were asked about the knowledge of sea level rise and high temperature and flood and sediment carried out by flood water. Only 20% respondent had knowledge on sea level rise and knew about high temperature. Majority of the respondents mentioned (78%) flood as natural process. Most of them (80%) knew about the sediment and benefit of sediments after flood. Each year a large percentage of the chars get flooded. People in many chars have to leave their homesteads due to floods, which entails a host of problems with regard to transportation, shelter, security and rehabilitation. The flooding is also a problem for those involved in livestock rearing since severe difficulties emerge with respect to shelter, transportation and marketing of the livestock. The island chars are found to be flooded more extensively than the attached chars. A total of 4.29 million people were reported to live in the main river char lands in 1992-93, out of these 1.85 million (43%) live on island and attached chars, and 42% live in the Brahmaputra-Jamuna char lands (Smith et al., 1998; EGIS, 2000; Thompson, 2000). It was found that majority of the respondents of this study knew the name of the natural disasters but in different terms (such as- they called "Ban" for flood, "Deowa" for rain etc). To overcome the natural disaster in char areas they change crop patterns with seasons, select time of cultivation after prediction of natural disaster and to survive and earn livelihood they also selected occupation with season. Minority of them (30-40%) visited health centre while sick, had saline for diarrhea and use sanitary latrine. Human health is ranked below other sectors because of the significant uncertainty about many impacts, although it is likely that

climate change will present increased health risks to Bangladesh. In particular, increased flooding could threaten human health through drowning and spread of disease.

### **5.3. Impact of climate change on Livelihood pattern of Char Dwellers**

The respondents of this study tried to cultivate crops with the season or climate. They cultivate mostly Boro and Rabi paddy during January to June. The labourers had busy time in Boro and Rabi **seasons**. These seasons covered the period from January to June (January for planting, March for weeding Boro paddy and May-June for harvesting Boro paddy). They also cultivated vegetables, pulse and some time jute. Mostly they used boat (90%) followed by rickshaw (40%), Van (30%) and bus (10%). From secondary data it was found that water resources are ranked as the greatest concern because flooding is already an important issue for the country. Increased flooding would no doubt be significant. Since small changes in runoff can substantially increase flooding, it is expected that increased flooding will be noticeable in the next few decades. The combination of increased glacial melt, which is highly likely, and increased monsoon intensity, which appears likely, makes increased flooding also likely. A majority of the interviewed floodplain residents are exposed every year during the rainy season to flooding, and a quarter of the population mentions flooding as the main problem faced by the region, followed by other important problems such as bad roads (23%), unemployment (20%) and lack of electricity (17%). The respondents of this study mentioned the same points. Most of the respondents mentioned reduced their livelihood options (80%), suffer from different types of diseases (**80%**), **earning** loss (90%), need to go for loan with high interest (90%), loan with high interest (60%), lost cattle and farm animals (90%). They also mentioned that they need to migrate (90%), loss of their and cattle' food (80%), become poor (80%) and interrupt education (96%). Most flood damage is caused by property and crop damage, followed by damage to fish ponds. The other damage category includes loss of income from day labour and trade.

### **5.4. Adaptation Strategy of the char dwellers**

Adaptation of the char dwellers livelihood to Climate change in future course of actions is one of the objectives of this study. To find out the options the respondents were asked about their opinion. The respondents mostly used pond and river water (42%) for daily uses. For drinking purposes they also used (40%) tube well. According to Alam (2002) for domestic water supply the only options for riverine char people are either river water or ground water using hand tube wells (HTWS), less than 2% use ponds. Most char



households now report using hand tube wells in normal circumstance even on island chars. However in high floods one major problem for char people is obtaining safe drinking water: tube well often go underwater, and travel from houses to HTWs is difficult. People who have evacuated from their homes also face difficulties in accessing HTWs if they have moved to public lands. In the study area only one fourth of the respondents used sanitary latrine. They mentioned the following options to adapt with the disastrous situation (climate change). They changed their crop pattern (80%), need place to stay during flood, cyclone etc natural disasters (80%), need high land to preserve livestock (86%), temporary income options needed (70%), need clean water supply (90%).

## CHAPTER 6 CONCLUSION AND RECOMMENDATION

### 6.1 Conclusion

Among 50 participants on an average age of the respondents was 35-53 years and slightly less than half (48%) were illiterate only 3% had higher education. About half (52%) of the respondents reported that agriculture was their main occupation. There were labourers (24%) and students (4%) as well. They were also involved in subsidiary occupation. Majority of the respondents of this study were Muslim. The average family size of the respondents was 5.5. One-fifth of the respondents were male and about 30% were female wage labourers among the working members of those households. Slightly more than half (68%) of the respondents spend less than 2000taka for food per month and only less than 5% of them spend more than 200 taka for education.

It was found from the secondary data that sea level rise for higher temperature would cause huge damage on the char dwellers living. Only 20% respondent had knowledge on sea level rise and knew about high temperature. Majority of the respondents mentioned (78%) flood as natural process. Most of them (80%) knew about the sediment and benefit of sediments after flood. It was found that majority of the respondents of this study knew the name of the natural disasters but in different terms (such as- they called "Ban" for flood, "Deowa" for rain etc). To overcome the natural disaster in char areas they change crop patterns with seasons, select time of cultivation after prediction of natural distruster and to survive and earn livelihood they also selected occupation with season. Minority of them (30-40%) visited health centre while sick, had saline for diarrhea and use sanitary latrine. They cultivate mostly Boro and Rabi paddy during January to June. The labourers had busy time in Boro and Rabi seasons. They also cultivated vegetables, pulse and some time jute. Mostly they used boat (90%) followed by rickshaw (40%), Van (30%) and bus (10%). The respondents of this study mentioned the same points. Most of the respondents mentioned reduced their livelihood options (80%), suffer from different types of diseases (80%), earning loss (90%), need to go for loan with high interest (90%), loan with high interest (605), lost cattle and farm animals (90%). They also mentioned that they need to migrate (90%), loss of their and cattle' food (80%), become poor (80%) and interrupt education (96%). The respondents mostly used pond and river water (42%) for daily uses. For drinking purposes they also used (40%) tube well. In the study area only one

forth of the respondents used sanitary latrine. They mentioned the following options to adapt with the climate change. They changed their crop pattern (80%), need place to stay during flood, cyclone etc natural disasters (80%), need high land to preserve livestock (86%), temporary income options needed (70%), need clean water supply (90%).

In conclusion it can be summarized as-

**6.1.1 Char Dweller's perception of climate change impact on livelihood options is as follows**

- Increase the damages of crops due to long period of flooding.
- High frequency of flood reduces their livelihood option.
- Unexpected flood is increasing recently.
- Livelihood diversification is growing with alarming rate.
- Increasing poverty.

**6.1.2 Coping strategies for these problem is as follows**

- Change of food habits
- Depending on credit loan with higher rate.
- During flood period Char Dweller's are obliged to sell their cattle for survival of both their meal and cattle feeding.
- Temporary migration during flood season.
- Influenced with different crops like Tobacco, Corn etc.

**6.1.3 The main adaptation options in these area is as follows**

- Priority on high land for preserve cattle and crops.
- During flood season temporary incomes are needed.
- Livestock rearing is properly preserved with proper policy adoption.

## 6.2 Recommendation

- Properly designed top-down scenario driven approaches to adaptation can play a role in reducing vulnerability to disaster prone areas.
- Safer places are needed for relocation of community people in safer areas during flood period.
- Strong house are needed to build with a high plinth level for reducing inundation.
- Shelters required for people, animals and agricultural inputs/products.
- Local awareness about climate change should be enhanced for generation of local people knowledge.
- Medical service should be accessed to all household in the community, such as doctors and veterinaries etc facility.
- Provide safe, reasonable and fair credit and insurance which will not confined with credit group of respectable institution but also other vulnerable Char Dweller's during flood season.
- For better communications, through safer roads and access to boats need to provided from different organization contribution.
- Develop knowledge and resources for crop diversification and adaptive agricultural practices like Tobacco already planted but need to proper wage rate.
- Loss from climatic hazards can be kept to a minimum level. Both the print and electronic media can play a significant role in spreading the programs to grass-root level.

A more detailed assessment needs to be conducted on how local transport, education, health, and water and sanitation infrastructure is currently affected by river floods and erosion. Dialogue with inhabitants, engineers and planners is necessary to devise appropriate design changes that limit anticipated impacts to an acceptable level. Future livelihoods and enterprise promotion will need to stress diversification of livelihoods strategies and be informed by participatory vulnerability assessment to develop locally appropriate responses that both reduce climate vulnerability and reduce poverty. And Materials should draw on local experiences of climate impacts and relate directly to char dwellers, Project shelter Char Dweller's and Inland Char Dweller's livelihood, informed by a participatory vulnerability assessment.

Adaptation options are urgently needed for the reducing Char Dweller's vulnerability. The results of this research are highlighted to understand adverse impact of climate change on Char Dweller's livelihood options and the draft adaptation menu was selected through bottom up approaches. However, a proper Climate change awareness for the char dwellers of Kazipara is strongly felt.

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